General Recommendations on Immunization

Childhood Schedule

Before we get into the General Recommendations, let's have a look at the most current schedule for routine vaccination of children. The 2004 schedule is located in Appendix A of your text. Appendix A follows page 296, the last page of the anthrax vaccine chapter.

Here is a graphic of the schedule. We call it the harmonized schedule because it's developed each year by the Advisory Committee on Immunization Practices – ACIP – and the American Academies of Pediatrics and Family Physicians. That way, all groups that recommend vaccines use the same format. Vaccines are listed down the left side, and ages across the top. Vaccine names are listed under the recommended age for each dose. Bars that span ages indicate a range in the recommended age for that dose. Notice also that this schedule includes only January through June 2004. A second schedule will be published in July.

Notice that the inactivated vaccines, hepatitis B, DTaP, Hib, and PCV can be started as early as 2 months of age, and require 3 to 5 doses. The first dose of hepatitis B vaccine is recommended to be given at birth, before the infant goes home from the hospital. Injected live vaccines, MMR and varicella, are not given until after the first birthday, due to the presence of maternal antibody, which could interfere with vaccine virus replication.

If you look down any age column, and follow vaccine rows to the left, you can see what vaccines a child needs to be adequately immunized for that age. For instance, at 4 months of age, a child should have received 2 doses of hepatitis B vaccine, 2 doses of DTaP, 2 doses of Hib, 2 doses of IPV, and 2 doses of PCV. Looking down the column marked 18 months, and counting to the left, you can see that by that age, a child should have received 3 doses of hepatitis B vaccine, 4 doses of DTaP, 3 or 4 doses of Hib, depending on the type of vaccine used, 3 doses of IPV, 4 doses of PCV and 1 dose each of MMR and varicella vaccines. That's what is referred to as SERIES COMPLETE, that these 19 or 20 doses of vaccine have been given by 18 to 24 months of age.

We will refer to tables in Appendix A several times during the next half hour. So mark this spot in your book so you can find it again later.

Now let's talk about the General Recommendations. If you only read one ACIP statement, it should be this one. If you do not already have a copy of the General Recommendations, we will tell you how to get a copy later in the program. Most

ACIP statements address a single vaccine or vaccination issue. The *General Recommendations on Immunization* is unique among ACIP statements because it provides guidance on vaccination issues common to more than one vaccine. The current version of the General Recommendations was published in 2002, and is the most comprehensive version ever produced. The picture on the cover is Edward Jenner administering the first documented dose of smallpox vaccine in 1796. New or significantly revised material in the 2002 General Recommendations includes an expanded discussion of **contraindications and precautions**; methods for **alleviation of discomfort** caused by injection; **prevention of adverse reactions**; and a section discussing vaccination of people with **latex allergy**. There are also sections discussing vaccination of **internationally adopted children** and **stem cell transplant recipients**, discussions of **immunization registries**, **benefit and risk communication**, and much more. There is even a section on vaccine administration.

We receive many questions about vaccine administration such as appropriate needle length and site. To address this we will discuss vaccine administration a little later in the program.

Spacing and Timing

We would like to discuss three issues from the General Recommendations that relate to the spacing and timing of vaccines. This material begins on page 9 of your book if you want to follow along.

The three interval issues we are going to discuss are the spacing of **antibody containing blood products** and measles vaccine, the spacing of **doses of different vaccines** not administered simultaneously, and the spacing of subsequent **doses of the same vaccine**. These issues come up frequently in vaccination practice and we get many questions about them. Let's begin with another general rule. **Inactivated vaccines** are generally **not affected by circulating antibody to the antigen**. As a result, inactivated vaccines can be given any time before or after antibody has been given, or in infancy when maternal antibody is still present. Live attenuated vaccines - at least injected ones - **may be affected by circulating antibody to the antigen**. The presence of circulating antibody may affect the age at which a vaccine is given, because of persistent maternal antibody. It may also influence the length of the interval between administration of an antibody containing product, such as a blood transfusion, and a vaccine dose. The interval between antibody and vaccine is most important for measles, and probably varicella. Mumps and rubella vaccines seem to be less sensitive to circulating antibody.

If a parenteral live virus vaccine is administered BEFORE the antibody containing product, an **interval of at least 2 weeks should separate** them. This interval allows the vaccine virus time to replicate and produce an immune response before encountering the antibody. If the ANTIBODY is given first, the interval between them should be **3 months or longer** depending on the antibody product and dose that was administered. On the occasions when you encounter this

situation, it would be useful to have a table that indicates the recommended interval between the antibody product and the live vaccine. There's a table of these intervals in the General Recommendations. Here's what it looks like. We also put this table in your book in Appendix A, on page A5. If you have your text handy, please find the table now.

You can see the table has three columns. The **first column** lists all the different antibody products available in the United States. The **second column** is the recommended dose for that particular product and indication. The **third column** lists the interval between receipt of that product and measles or varicella vaccine administration.

Let's look at three examples. Find the third line, labeled hepatitis A. The second column gives the routine prophylaxis dose of immune globulin. The third column shows the suggested interval before measles vaccination is 3 months. This means that this amount of antibody should have waned enough in 3 months to allow replication of measles and varicella vaccine virus. Near the middle of the page, under blood transfusion, find whole blood. Notice the suggested interval between a transfusion of whole blood and measles or varicella vaccine is 6 months. At the bottom of the table are 4 rows for intravenous immune globulin, or IGIV, for various indications, such as the treatment of immune thrombocytopenic purpura and Kawasaki disease. Because of the amount of antibody present in IGIV, 8 to 11 month intervals are recommended between its administration and live virus vaccination. You should be aware that many children with HIV infection are on routine IGIV schedules, so you may need to check this table for intervals before administration of MMR or varicella vaccine.

The antibody table also includes entries for two antibody products available for the prevention of RSV. **RSV-IGIV is an intravenous human hyperimmune globulin**, so **live vaccines should be delayed at least 9 months** after administration, similar to the interval following regular intravenous immune globulin. **Synagis**, at the top of the table, is another antibody product for the prevention of RSV. It contains monoclonal antibody, and does not contain ANY antibody except RSV. So Synagis **does not interfere with live virus vaccination**, because it doesn't contain measles, mumps, rubella, or varicella antibody. The interval between Synagis and live virus vaccines is ZERO. Live virus vaccines can be administered any time before or after administration of Synagis.

We strongly suggest that you use the intervals in this table if your client has received some type of blood product and needs MMR or varicella vaccine. If for some reason one or both vaccines are given at an interval SHORTER than those in the table, you should either repeat the vaccine dose at a later time, or use a laboratory test to verify that there has been a response to the vaccine. Administering a second dose is probably the easiest and cheapest course of action.

Do not memorize the antibody table. When you get back to your office copy it, laminate it, post it, and explain it to other members of your staff- whatever it takes so everyone knows how to use it and where to find it. If you need an updated copy of the table, you can get it from our broadcast resources website.

The next segment of the program addresses simultaneous and nonsimultaneous administration of vaccines. The next general rule of vaccination is one that we will mention often during this course. **There are no contraindications to the simultaneous administration of any vaccines**. Let me repeat that: there are no contraindications to the simultaneous administration of any vaccines used in the United States.

The simultaneous administration of vaccines is absolutely critical to raising and maintaining high immunization levels. Simultaneous administration neither decreases vaccine efficacy nor increases the risk of adverse reactions. It does NOT overload the immune system which is very capable of coping with many antigens every day. Simultaneous administration is also preferred by most parents, who would rather make one trip to your office rather than two. Finally, simultaneous administration of all needed vaccines helps assure that children are protected, so it's the right thing to do.

So what about vaccines that are not given simultaneously? For instance, a child got his one year vaccines from his primary care provider, but that practice does not stock varicella vaccine. So he is sent to the public health clinic for that vaccine. What do you do? Do you have to wait? The only time that a specific interval should separate two vaccines not given on the same day is when both of them are live and both are injected. If **two live injected** vaccines are not given simultaneously, they should be separated by at least 4 weeks. **All other combinations** of inactivated, or live and inactivated vaccines may be administered at any time before or after each other without waiting.

The recommendation to separate live virus vaccines by at least 4 weeks results from concern that the vaccine given FIRST could interfere with response to the vaccine given SECOND. These concerns were initially based on two 1965 studies that indicated that recent measles vaccination reduced the response to smallpox vaccine. In 2001, the National Immunization Program conducted a study using the Vaccine Safety Datalink System to investigate risk factors for varicella vaccine failure- children who got chickenpox even though they had been vaccinated.

This study found that children who received varicella vaccine less than 30 days after MMR vaccination had a significantly increased risk of breakthrough varicella compared to those who received varicella vaccine before, simultaneous with, or more than 30 days after MMR. This study provided additional evidence that interference can occur between two live vaccines given less than 28 days apart. ACIP now recommends that when two parenteral live vaccines are not given on the same day but are separated by less than 28 days, the live vaccine given SECOND should be repeated, unless serologic testing indicates that a response

to the vaccine has occurred. For example, if a dose of MMR were given 2 weeks after a dose of varicella vaccine, the MMR should be repeated. The repeat dose should be spaced at least 4 weeks after the invalid dose.

An exception to this rule is single antigen measles vaccine followed by yellow fever vaccine. Data are available that show that measles vaccine does not interfere with yellow fever vaccine given as soon as 7 days later. Remember -- you can and should give all routine vaccines simultaneously. That's the gold standard. The alternatives I'm discussing here are only for situations when there has been a problem and simultaneous administration did NOT occur. I'd also like to emphasize that live vaccines not given simultaneously need to be separated by at least 4 weeks only if they are injected. The 4 week separation rule does not apply to oral polio, oral typhoid vaccine, or live attenuated influenza vaccine. Live vaccines that are not injected can be given at any time before or after any other vaccine, either live or inactivated.

You should always try to keep the child on the routine schedule. And make sure the parents know the importance of keeping on schedule. But sometimes things just do not go according to plan. Children sometimes are brought in early. Or, more commonly, a child is behind in the schedule and needs to be caught up. Also, spacing becomes an issue when assessing a record of vaccines given outside the United States, since non U.S. schedules may differ from those used here. Here is the General Rule that applies to this situation. **Increasing**, or lengthening, the interval between doses of a multidose vaccine does not diminish the ultimate effectiveness of the vaccine, after the series has been completed. However, **decreasing the interval** between doses of a multidose vaccine may interfere with antibody response and protection. Remember, while an increased interval between doses doesn't ultimately reduce antibody titers or protection, it may compromise protection in the short run, because the series is incomplete.

So, if the minimum intervals are so important, it would seem reasonable that there should be a table listing them somewhere. And there is. Arguably, the centerpiece of the 2002 *General Recommendations on Immunization* is Table 1. This table contains a listing of every dose of every commonly used vaccine. We also included this table in Appendix A of the book if you want to find it. Here is a close-up of Table 1. The table has five columns. The **first column** lists the vaccines by dose. The **second column** indicates the RECOMMENDED AGE for that dose. This is the age listed on the childhood schedule. The **third column** lists the MINIMUM AGE for that dose. Vaccine doses should never be given at an age younger than the minimum age. The **fourth column** indicates the RECOMMENDED INTERVAL to the next dose. Like the recommended age, this is information found on the routine childhood schedule. The **fifth column** indicates the MINIMUM INTERVAL to the next dose. Doses of vaccine should never be spaced closer than the minimum interval. As you can see, this single table provides all the information you need for scheduling vaccine doses. Be sure to have a close look at it, either in the General Recommendations or in Appendix A of your book. And be sure to read all the footnotes.

ACIP recommends that providers schedule vaccines as close to the recommended age and intervals as possible. The recommended schedule, age for specific doses, and spacing of doses is supported by data from clinical trials of the vaccine. There are times when it is necessary to give vaccines earlier or closer together than recommended in the routine schedule. Minimum ages and intervals can be used in these circumstances, for instance **when a person is behind on the schedule**, and it's necessary to catch them up. Minimum ages and intervals could also be used in other situations when the vaccination schedule **may need to be accelerated**, such as when international travel is impending. While there are less scientific data supporting the use of minimum intervals and ages, ACIP believes that the response to doses given at minimum intervals and ages will be acceptable.

In practice, vaccine doses are sometimes administered earlier than the minimum age or minimum interval. In the past, ACIP has recommended that doses of vaccine separated by less than the recommended minimum interval- even one day less- should not be considered part of a primary series. ACIP continues to recommend that vaccine doses should not be given at less than the minimum interval or earlier than the minimum age. But in an effort to increase the flexibility of the complicated childhood immunization schedule, ACIP now recommends that **vaccine doses administered up to 4 days before the minimum interval or age can be counted as valid**. This four day period before the minimum age or interval is being referred to as the grace period. ACIP believes that administering a dose a few days earlier than the minimum interval or age is unlikely to have a significant negative effect on the immune response to that dose. This four day grace period can be applied to all ages and intervals listed in Table 1.

The grace period should NEVER be used when scheduling future vaccination visits. It should be used primarily when reviewing vaccination records, such as for daycare or school entry. The 4 day grace period may also be useful in situations where a child visits a provider a few days earlier than a scheduled vaccination appointment. For example, if a child comes to the office or clinic for an ear check 27 days after his or her second DTaP dose, the provider could administer the third DTaP at that visit rather than having the child return for vaccination the next day. The 4 day grace period recommendation by ACIP may cause a **conflict with some state school entry requirements**. For instance, most state school requirements mandate the first dose of MMR to be given on or after the first birthday. As a result, **not all states will accept the grace period for some or all vaccine doses**. Providers should **determine their state program's position on this before using the grace period**. The reason that some states are not accepting the grace period is because to do so would mean changing the school requirement or law, which often requires an act of the state legislature. So be sure to check with your state immunization program before adopting the grace period.

Remember to stay on the routine schedule whenever possible. But sometimes children fall behind. If this happens you need to do several things -- talk to the

parent about the importance of staying on schedule; flag the chart for special attention; and speed up, or accelerate, the vaccination schedule. This means giving doses with the minimum acceptable intervals until the child is caught up. In 2003, for the first time, ACIP and the Academies of Pediatrics and Family Physicians published a harmonized catch up schedule. The one you see here is for children 4 months through 6 years of age. There is also a version for children 7 through 18 years of age. The information in the catch up schedule is basically the minimum interval information from Table 1 in a condensed form. You need to be familiar with the catch up schedules. Be sure to take some time to look at it carefully. And, of course, read all the footnotes. The catch up schedules are in Appendix A, and are also available on the NIP website.

Table 1 of the General Recommendations, and the new catch up schedules address the minimum acceptable interval between doses. But what if the interval is too long? It is **not necessary to restart the series of any vaccine due to an extended interval between doses**. The one possible exception to this is oral typhoid vaccine, which you are not likely to use unless you deal with travelers. Extended intervals between doses happen all the time. Healthcare workers sometime decide to take a year or two off between doses of hepatitis B vaccine. Adolescents may only make it into their doctor's office once a year. Sometimes parents just forget, or do not understand the importance of staying on schedule. If the interval between doses is longer than the recommended interval, you do NOT have to restart the series or add doses. Just pick up where you left off, and try to get the rest of the doses in on time.

So, the main issues on spacing and timing of vaccines are the timing of antibody containing products and live parenteral vaccine, spacing of doses of different vaccines, and spacing of doses of the same vaccine. These issues arise frequently in practice, so you need to be clear on them. These issues and more are discussed in the General Recommendations. We strongly suggest that you get a copy if you do not already have one, and take some time to read it.

Adverse Reactions

In this section of the program we'll talk about adverse reactions, and the vaccine adverse events reporting system. As always, we begin by defining our terms.

The intended effect of vaccination is to produce active immunity to specific antigens. An adverse REACTION is an unwanted **extraneous effect caused by a vaccine**. A synonym of adverse reaction is vaccine **side effect**. A vaccine adverse EVENT, on the other hand, refers to **ANY event** that occurs following a dose of vaccine. So an adverse event **may be a true adverse reaction**, or **may be only coincidental**, with further research needed to distinguish between them. This terminology may be new to you, and it's not meant to be confusing. It's meant to increase the precision of discussions of vaccine safety. Adverse REACTIONS are known to be caused by the vaccine. Adverse EVENT is a more generic term that does not necessarily imply a cause and effect relationship with the vaccine.

Vaccine adverse reactions fall into three general categories- **local, systemic, and allergic**, listed here in order of decreasing frequency and increasing severity. The most common type of adverse reactions are **local** reactions, such as **pain, swelling, and redness** at the site of injection. Local reactions may occur in up to 50 percent of vaccine doses, depending on the type of vaccine. Local reactions are most **common with inactivated vaccines**, particularly those that contain adjuvants, such as DTaP and pneumococcal conjugate vaccines. Local adverse reactions generally occur within a few hours of the injection and are **usually mild and self-limited**. Occasionally, local reactions may be exaggerated. Some people refer to these as hypersensitivity reactions, but this is a misnomer, since they're not allergy mediated, as the term implies. These reactions are properly known as Arthus reactions, and are most commonly seen after tetanus and diphtheria toxoids. They are believed to be due to a very high concentration of antibody, usually because of too many doses of toxoid in too short an interval.

A second type of adverse reaction is referred to as **systemic**. These are more generalized symptoms, and include **fever, malaise, headache**, myalgias or muscle pain, loss of appetite, and others. You may notice that these symptoms are common and **nonspecific**, and may occur in a vaccinated person because of the vaccine, or may be caused by something totally **unrelated to the vaccine**, like a concomitant viral infection. Systemic adverse reactions were relatively frequent with whole cell bacterial vaccines, like DTP. However, they're less common following inactivated vaccines currently in use, including DTAP. We know systemic adverse reactions are not common because of studies that compare vaccine and placebo recipients. The rates of systemic reactions are often similar in both groups, indicating that few of the reactions are actually due to the vaccine. Systemic adverse reactions from live vaccines are a different situation. Live attenuated vaccines **must replicate in order to produce immunity**. The symptoms you would expect as side effects following live vaccines are basically a **mild case of the disease**. These adverse reactions occur **after an incubation period of the virus,** which is seven to 21 days for MMR and varicella. As an example of a systemic adverse reaction to a live vaccine, consider measles. The most common symptoms of measles disease are fever and generalized rash. These symptoms- in a milder form- are also the most common adverse reactions following measles vaccine, occurring in 5 to 10 percent of recipients. An exception to this general rule is smallpox vaccine. Smallpox vaccine doesn't contain attenuated smallpox virus. It contains vaccinia virus, which is in the same family as smallpox virus, but causes a much less severe illness. So the symptoms following smallpox vaccine are NOT like a mild case of smallpox. They are symptoms of infection with vaccinia virus.

A third type of adverse reaction is a severe **allergic** reaction. The allergic reaction may be caused by the vaccine antigen itself, or, more likely, by some other **component** of the vaccine, such as cell culture material, stabilizer, preservative, or antibiotic used to inhibit bacterial growth. Severe allergic reactions to vaccines are very **rare**, occurring at a rate of less than one in half a

million doses. But they may be life threatening. The risk of an allergic reaction can be **minimized by good screening** prior to vaccination. We will talk more about allergies and screening for them a little later.

So to review, adverse reactions can be generally categorized as local, systemic, and allergic. Local reactions are fairly common and usually mild, systemic reactions less common, and allergic reactions are rare but can be severe.

We'll be talking about adverse reactions in more detail as we talk about the specific vaccines.

The National Childhood Vaccine Injury Act of 1986 requires healthcare professionals and vaccine manufacturers to report certain vaccine adverse events. In 1990, a reporting system was put into place to assist providers and families with this requirement. The system is called the Vaccine Adverse Events Reporting system, or VAERS. VAERS is a cornerstone of adverse events monitoring in the United States, so it's important that you understand how it works and what it does. We asked Doctor John Iskander, a vaccine safety expert in the National Immunization Program, to tell us about the system.

Iskander: *The Vaccine Adverse Event Reporting System, or VAERS, is a vaccine safety surveillance system that was established to provide a single system for the collection and analysis of reports of adverse events following vaccination. CDC and the FDA work together on the system. I would like to stress two important take home messages. First, VAERS is the nation's frontline vaccine safety surveillance system, and second, your contributions to VAERS in the form of electronic and hard copy reports are absolutely vital. [CAM] VAERS is a unique public health surveillance system that relies on health care providers, as well as patients and parents, to report adverse events that they think might be related to vaccination. The CDC and FDA continually monitor the safety of vaccines by evaluating cases and data from VAERS.*

VAERS provides ongoing surveillance for vaccine safety. New systems do not need to be set up to monitor a new vaccine, such as the live attenuated influenza vaccine. VAERS relies primarily on voluntary reporting from the users and recipients of vaccines, so it cannot work without you! Because VAERS is a national system, rare events that happen in isolation can be noticed as patterns within the system, and flagged rapidly for further study. This is one of the main strengths of VAERS.

VAERS was established in 1990 after Congress passed the National Childhood Vaccine Injury Act. The Childhood Vaccine Injury Act requires health care providers to report the events listed on a table of designated Reportable Events. VAERS depends on the reporting of ANY clinically significant event, most of which are not listed on the Reportable Events Table. We are often asked what is meant by "clinically significant". Post- vaccination medical occurrences that are of concern to you, or the patient or parent, are clinically significant. Any event that

you suspect MIGHT have been due to a vaccination, even if you are not certain, should be reported.

Now let's talk about how VAERS works. Many vaccine providers have heard of VAERS and have seen a copy of the VAERS reporting form. Copies are sent each year to primary health care providers. The form can be obtained from the VAERS website at www.vaers.org or by calling the telephone number found on every Vaccine Information Statement. In addition, reporting through a secure web site is available at www.vaers.org. Secure web-based reporting is more timely and potentially more accurate. The VAERS form is postage paid, with the address and instructions on the back. The completed form can also be faxed to a toll free number. In addition to reporting forms, the VAERS website provides a wealth of information including a continuing education article. The article offers continuing education credits for physicians, nurses, and other professionals.

Once VAERS receives a report, a letter is sent out to the person who submitted it. The letter provides a thank you, the assigned VAERS ID number, and may request additional information. A team of nurses conducts follow up on all reports considered serious. This follow up is done to obtain more complete clinical information about the reported event. In addition to the VAERS form, VAERS welcomes hospital or clinic summaries or other medical records. These can be submitted with the original report, or later, accompanied by the VAERS ID number. Additional medical information is extremely useful in evaluating case reports.

To show you how VAERS works, let me give the best example of why collecting reports that are merely suspected to be related to a vaccination, is vitally important. Before the rotavirus vaccine was licensed in the fall of 1998, investigators noted a few cases of a bowel disorder called intussusception in both vaccine recipients and those who received a placebo. Although the rate among vaccine recipients was slightly higher, it was not statistically significant. Therefore, the vaccine was licensed, but intussusception was included in product information among the list of possible adverse reactions. Once the vaccine was widely distributed, VAERS began to receive adverse event reports, including cases of intussusception. The number of cases reported relative to the number of doses distributed was much higher than what was expected. This suggested, but did not confirm, that this vaccine might rarely cause intussusception. Subsequent controlled studies confirmed that the risk of intussusception was higher after vaccination, and the rotavirus vaccine was withdrawn.

The system worked. VAERS data indicated a possible problem which led to a more definitive study, which led to policy action to protect the public health. The story of Rotavirus vaccine highlights the importance of reporting events even when the reporter may be unsure that the vaccine was responsible. Vaccine safety concerns raised by VAERS will be carefully evaluated before any action is taken.

So, as the cornerstone of the country's vaccine safety monitoring system, VAERS is always "on call" to receive case reports of any adverse event

suspected to be related to any U.S. licensed vaccine. A few important points: VAERS accepts all reports of adverse events. Events that are related, as well as those that are unrelated to vaccination, end up in VAERS. VAERS reports are screened and evaluated on an ongoing basis by teams of researchers at the CDC and FDA. Concerns are flagged and further assessed, as illustrated by the example of intussusception. VAERS relies on the astute health care provider to notice and report adverse events that may be related to vaccination.

Thank you for this opportunity to discuss the Vaccine Adverse Event Reporting System. Because in the end, it relies on you to help make sure that vaccines continue to be held to high standards of safety. All vaccine providers can contribute to the success of this system by reporting any adverse event that might be related to vaccination in either children or adults. The system works because YOU make it work.

Contraindications and Precautions

Vaccine safety is a common concern to both providers and patients. Fear is increased by sensational, unbalanced journalism. If you have the facts you can be ready for the questions. We've included a good chapter on vaccine safety in the text, and there is an extensive vaccine safety resource listing in Appendix F.

In 1998 we produced an entire satellite broadcast on vaccine safety and risk communication. Videotapes of this program are available free from the National Immunization Program.

Earlier in the program we discussed vaccine adverse events, and adverse event reporting. In this segment we would like to discuss a related issue, contraindications and precautions, and screening.

We include fairly detailed information about contraindications to vaccination, because this is a common topic of questions we receive. Information on contraindications and precautions to vaccination begins on page 15 of your book if you want to follow along.

From a practical standpoint, you know that when a contraindication or precaution to a vaccine is present, you usually do not give a dose of that vaccine. But let’s define these terms a little more precisely. A contraindication is a condition in a recipient which greatly **increases the likelihood of a serious adverse reaction**. A contraindication is a condition in the RECIPIENT, NOT with the vaccine itself. If the vaccine were given in the presence of that condition, the resulting adverse reaction could seriously harm the recipient. The risk of an adverse reaction outweighs the benefit, so you will rarely, if ever, give a vaccine when one of these conditions is present.

A precaution is similar, but not identical, to a contra-indication. A precaution is a condition in a recipient that **MAY increase the likelihood of a serious adverse reaction** or cause an adverse reaction to be more severe, or; a condition that

may **compromise the ability of the vaccine to produce immunity**. Injury from the vaccine could result, but the chance of this happening are less than with a contraindication. In usual practice you generally won't give the vaccine if a precaution is present. But there may be situations when the benefit of the vaccine outweighs the risk of an adverse reaction, like during an outbreak of the disease. In these situations, you may decide to give the vaccine.

There are very few true contraindications and precautions, so let's go through them briefly. Please note that there are contraindications unique to smallpox vaccine. We will mention them in this segment, and provide more detail when we discuss smallpox vaccine in our third session.

There are only two **permanent contraindications** to the use of routine vaccines. The first, which applies to all vaccines, is a **severe allergic reaction to a vaccine component or following a prior dose of vaccine**. The second is encephalopathy within 7 days of **pertussis vaccination**. For smallpox vaccine, a history of eczema or atopic dermatitis in the person or a household contact is a permanent contraindication to pre-event vaccination. What do we mean by severe allergy? This is an allergic reaction that is immediate and life threatening, also called anaphylaxis. Severe IgE mediated allergy usually presents as hypotension, respiratory difficulty, such as wheezing, or generalized urticaria or hives. Fortunately, these types of reactions are extremely rare following vaccination.

There are several other conditions that are temporary contraindications or precautions. And whether the condition is a contraindication or precaution depends on the vaccine being used. Here's a table that lists the conditions. This table is also on page 16 of your book. The "C" indicates a contraindication, "P" indicates precaution, and "V" means vaccinate if indicated. As I mentioned, severe **allergy** to a vaccine component or a prior dose of vaccine is a contraindication to both live and inactivated vaccines. **Encephalopathy** is a permanent contraindication that applies to pertussis vaccines. **Pregnancy** is a contraindication to live vaccines because of the theoretical possibility of infection of, and damage to, a fetus. No vaccine except smallpox vaccine has ever been shown to actually damage a fetus, but it's a good idea to be conservative anyway. Since inactivated vaccines do not replicate, they may be used if indicated. Pregnancy in a household contact is not a contraindication to any vaccine except smallpox vaccine. **Immunosuppression** is a contraindication to most live vaccines. Inactivated vaccines may be given if indicated. We will discuss immunosuppression in more detail in a moment. **Moderate or severe acute illness** is a temporary precaution to both live and inactivated vaccines. It is reasonable to defer vaccination until the acute condition has improved. So what do we mean by moderate or severe? As a rule of thumb, any illness that may require hospitalization or additional medical care after the immunization visit is reason to delay the vaccine. The ACIP has never recommended a maximum temperature for giving vaccines. Fever may not be a very good indication of severe illness in an infant anyway. You will need to use your professional judgment. But minor illnesses with or without low grade fever are certainly NOT

reasons to defer vaccination. **Recent receipt of a blood product** is a precaution to MMR and varicella vaccines because of interference with viral replication. Recent blood products have little or no effect on inactivated vaccines. This is a good example of the difference between a contraindication and a precaution. Giving measles vaccine shortly after a blood transfusion will not harm the vaccine recipient. But the antibody will probably inactivate the vaccine virus, and no immunity will result from the vaccination. And as we discussed earlier, recent blood products do not interfere with the response to inactivated vaccines.

There are a few other precautions which are specific to pertussis vaccine, such as fever of 105 or a seizure following vaccination. We will discuss these in more detail when we talk about pertussis vaccine. We will also discuss the contraindications unique to smallpox vaccine in our third session.

We receive many questions about vaccination of immunosuppressed persons, so we would like to discuss this in a bit more detail. An immunosuppressed person may be more likely to have a serious adverse reaction to a live vaccine than a person with a normal immune system. There are both diseases and drugs which can cause significant immunosuppression. First the diseases. Persons with **congenital** immunodeficiency, **leukemia, lymphoma, or generalized malignancy** should not receive live vaccines. Certain drugs and therapies may cause immunosuppression. For instance, people receiving cancer treatment with **alkylating agents or antimetabolites, or radiation therapy** should not be given live vaccines. Live vaccines can be given after chemotherapy has been discontinued for at least 3 months if the disease for which the therapy was given is in remission.

People receiving large doses of corticosteroids should not receive live vaccines. This would include those receiving **20 milligrams** or more of prednisone daily, or **2 milligrams or more per kilogram** of body weight per day. **Aerosolized steroids**, such as inhalers for asthma, **topical preparations, alternate day, or short high dose courses** are not contraindications to vaccination. Short term means less than 14 days. For people who have received high dose steroids for more than 14 days, you should wait at least a month after discontinuation of therapy before administering a live virus vaccine.

Persons with HIV infection who are mildly immunosuppressed and not severely symptomatic are recommended to receive **measles mumps rubella** vaccine. This is because of the high risk of complications of measles disease in these people. In addition, in 1999 ACIP recommended that susceptible people with asymptomatic HIV infection receive **varicella vaccine** for the same reason- to prevent complications of the disease. **Smallpox vaccine** should NOT be given to anyone with HIV infection regardless of symptom status. **All inactivated vaccines** may be administered to a person with HIV infection if indicated.

Inactivated vaccines may be administered if indicated to ANY immunosuppressed person, but response to the vaccine may be poor. A good immune response to an inactivated vaccine requires a relatively functional

immune system. So the person may not be fully protected even if the vaccine has been given. But a little protection is better than none at all if you do not administer the vaccine.

One additional issue related to immunosuppression is the vaccination of people who have received **hematopoietic stem cell transplants**, including bone marrow transplants. Research has shown that antibody titers to vaccine preventable diseases decline during the 1 to 4 years after stem cell transplant if the recipient is not revaccinated. It's been common practice in transplant centers to revaccinate stem cell transplant recipients, but vaccination protocols varied widely among centers. In 2000 CDC published guidelines for prevention of opportunistic infection- including vaccine preventable infections- among stem cell transplant recipients. These guidelines were developed in association with ACIP, the Infectious Diseases Society of America, and the American Society of Blood and Marrow Transplantation. **Influenza vaccine** should be administered prior to stem cell transplant if possible, and resumed 6 months following transplant. Influenza vaccine should be administered annually thereafter. The series of all other **inactivated vaccines** recommended for the person's age group should be repeated. The repeat series should begin 12 months after transplantation. The inactivated vaccines that should be repeated include **DTaP or adult Td**, depending on age, **IPV**, and **hepatitis B** vaccine. **Hib** vaccine is also recommended for all age groups. **MMR vaccine** is recommended to be given 24 months after transplant, if the person is immunocompetent. Immunocompetent means that the person is not on major immunosuppressive therapy and does not have graft versus host disease. **Varicella** and **pneumococcal conjugate vaccines** are currently not recommended for stem cell transplant recipients because of a lack of safety and efficacy data.

An extremely important adjunct to prevention of vaccine preventable diseases in stem cell transplant recipients- as well as other immunosuppressed people- is to assure that family members, household contacts, and healthcare workers are immune. **Healthy household contacts of immunosuppressed persons SHOULD receive MMR and varicella vaccines, as well annual inactivated influenza vaccination**. There is no risk of transmission of MMR vaccine virus to the immunosuppressed person, and the risk of transmission of varicella vaccine virus is extremely small. If you do NOT vaccinate the healthy person, they remain susceptible and may be infected with the wild virus, particularly varicella. A person with the DISEASE presents a real threat to an immunosuppressed household contact. Because of the risk of contact transmission, smallpox and live attenuated influenza vaccines should NOT be given to a person with an immunosuppressed household contact.

Recommendations for vaccination of immunosuppressed persons are detailed in the General Recommendations, and in a specific Altered Immunocompetence ACIP statement. These documents, and the complete stem cell transplant document are available to download from the MMWR website. The stem cell transplant document is long -- 130 pages – so we extracted the background and

vaccine recommendations and made a shorter version available on our broadcast resources website.

The key to reducing the risk of a serious adverse reaction is SCREENING for contraindications and precautions. Every person who administers vaccines should screen EVERY person before giving the shot. Effective screening is not difficult or complicated. It can be accomplished with just a few questions.

Many states have developed screening questionnaires for use in their clinics. You can develop your own sheet, or you can adapt one that has already been developed. The Immunization Action Coalition has developed a good one page screening sheet for children and another for adults.

It is important for you to understand the reasons for the questions on the screening form. We asked Doctor Deborah Wexler, Executive Director of the Immunization Action Coalition, to review the screening form with us, and explain the rationale for the questions.

Wexler: *The key to reducing the risk of a serious adverse reaction is to identify contra indications and precautions to vaccination BEFORE giving the shot. Contraindications to vaccination can change from one dose of a vaccine to the next dose. So everyone should be screened prior to EVERY dose, even if they were screened during a prior visit. Screening for contraindications and precautions isn't difficult or complicated. This is the screening form we developed for children and teens. We suggest you use a standardized screening form like this one, so you ask the same questions every time. Let's go through the 9 screening questions and talk about why you are asking them.*

Is the child sick today?

Wexler: *The first question addresses whether the child has a moderate or severe acute illness, which is a precaution to vaccination. If the child has been examined, this question may not be necessary, or already may have been answered. There's no evidence that acute illness reduces vaccine efficacy or increases vaccine adverse events. But with moderate or severe acute illness, vaccines should be delayed until the illness has improved. This avoids confusing a symptom of the illness - such as fever - with a vaccine adverse event, or vice versa. Mild illnesses, such as otitis media or an upper respiratory infection, are NOT contraindications to vaccination. Nor is taking antibiotics a reason to withhold a vaccine in a person who is otherwise not very sick.*

Does the child have allergies to medications, food, or any vaccine?

Wexler: *A severe allergic reaction to a vaccine or vaccine component is a contraindication to subsequent doses of that vaccine, or to a vaccine containing that component. An anaphylactic reaction to eggs is a contraindication to influenza vaccine, and an anaphylactic reaction to yeast is a contraindication to hepatitis B vaccine. We suggest you inquire about allergies in a generic way,*

rather than read the parent a list of every component of every vaccine. Most parents won't recognize most of these components names anyway. But they WILL know if the child has ever had an allergic reaction severe enough to seek medical attention, which is what you're getting at. If you do identify a person who has had a severe allergic reaction to a product that may be in a vaccine, the next challenge is to figure out which vaccines might contain that product. To make this task easier, you need a listing of vaccine contents. A comprehensive table of vaccine components is available free from the National Immunization Program website. Remember that a local reaction, such as redness or swelling at the site of injection, is NOT a contraindication to subsequent doses of that vaccine.

Has the child had a serious reaction to a vaccine in the past?

Wexler: *This open ended question is intended to identify allergic reactions following previous vaccine doses. It can also help identify conditions following pertussis vaccine. Under normal circumstances, vaccines are deferred when precautions are present. But situations may arise when the benefit of the vaccine outweighs the risk. For instance, a child who had a temperature of 105 following a prior dose of DTP or DTAP might still be vaccinated if there were an outbreak of pertussis in the community.*

Has the child had a seizure or a brain problem?

Wexler: *DTaP is contraindicated in children who have a history of encephalopathy within 7 days following whole cell DTP or DTaP vaccine. An undiagnosed neurologic problem is a precaution to the use of DTaP. For children with a STABLE neurologic disorder, including seizures, unrelated to vaccination, or for children with a family history of seizure, you should vaccinate as usual. In these children, you should consider the use of acetaminophen or ibuprofen to minimize the fever.*

Does the child have cancer, leukemia, AIDS, or any other immune system problem?

Wexler: *Live virus vaccines, such as MMR and varicella, are usually contraindicated in persons with severe immunodeficiency. However, MMR and varicella are recommended for persons infected with HIV who do not have evidence of severe immunosuppression. Varicella vaccine is contraindicated in persons with cellular immunodeficiency, but may be administered to persons with humoral immunodeficiency. All inactivated vaccines may be given to immunosuppressed persons, although the response to the vaccine may be suboptimal. Also remember that having an immunosuppressed person in the household is NOT a contraindication to vaccination of a healthy child.*

Has the child taken cortisone, prednisone, other steroids, or anticancer drugs, or had x-ray treatments in the past 3 months?

Wexler: *High daily doses of corticosteroids for more than 14 days can cause significant immunosuppression and increase the chance of an adverse reactions*

following a live vaccine. Live vaccines should not be administered for at least one month following prolonged high-dose steroid therapy, or for at least 3 months following cancer chemotherapy. Persons receiving aerosolized steroids, such as inhalers for asthma, topical preparations, or low or moderate daily or alternate-day doses of steroids for fewer than 14 days can receive live vaccines during treatment. For those receiving high dose daily or alternate day courses for fewer than 14 days, the American Academy of Pediatrics recommends that live vaccines be deferred until steroid therapy is discontinued. Similar to other immunosuppressive conditions or therapies, inactivated vaccines may be administered to a person receiving high dose steroid therapy, although the response to the vaccine could be reduced.

Has the child received a transfusion of blood or blood products, or been given a medicine called immune or gamma globulin in the past year?

Wexler: *Passively acquired antibody may reduce the effectiveness of MMR and varicella vaccines. MMR and varicella vaccines generally should not be given to people who have recently received antibody containing blood products. Depending on what product was administered, and the dose, it may be necessary to defer MMR and varicella vaccines for up to 11 months after the blood product. The 2002 General Recommendations on Immunization includes a table that lists the most commonly used antibody containing preparations in the United States. It also lists the recommended waiting period between the blood product and administration of MMR or varicella vaccine. Every office should have a copy of this table, which can be obtained from the National Immunization Program. This question might also uncover unreported illnesses that might not have been revealed in earlier questions, since blood products are usually given for specific indications.*

Is the child or teen pregnant, or is there a chance she could become pregnant during the next month?

Wexler: *This question should be asked of all women of child bearing age, including young adolescents. MMR and varicella vaccines are contraindicated shortly before and during pregnancy due to the theoretical risk of virus transmission to the fetus. Sexually active women who receive MMR or varicella vaccine should be instructed to practice careful contraception for one month following receipt of either vaccine. Inactivated vaccines generally may be given to pregnant women when indicated. On the other hand, it's not necessary to inquire about pregnancy in household contacts. Having a pregnant woman living in the household is NOT a contraindication to administration of ANY vaccine to other household members.*

Has the child received any vaccinations in the past 4 weeks?

Wexler: *The intent of this last question is to identify persons who recently received a live virus vaccine. The Advisory Committee on Immunization Practices recommends that two live virus vaccines not given on the same day be separated by at least 28 days. If the vaccine given recently was an*

INACTIVATED vaccine, such as DTAP or hepatitis B vaccine, it's not necessary to defer ANY vaccine. In addition to the child and teen screening form, we have also developed a screening form for adults. It contains the same questions that are on the child and teen form, except for the question about a history of seizures. The seizure question is included on the child and teen form to identify potential precautions for pertussis vaccine. Since pertussis vaccine is not given to people older than 7 years of age, it isn't needed on the adult form.

Both these screening forms, as well as other vaccine related material for providers and patients are available free from the Immunization Action Coalition website. But whether you use our form, or some other form, the important thing is that you to ask these questions before administering vaccines to people of any age. Your patients are depending on you to make vaccines as safe as they can be. Screening every patient is one way to do this.

As Dr. Wexler mentioned, the screening forms are available on the Immunization Action Coalition website. Other useful documents, such as the vaccine content and antibody tables, are available to you on the National Immunization Program broadcast resource website. We also included the screening forms and tables in Appendix A of your book. Please get these forms and tables from one of these sources, and use them. And a reminder- smallpox vaccine is a unique vaccine, and has several contraindications that apply to it alone. For example, pregnancy of a household contact is not a contraindication to any vaccine EXCEPT smallpox. We will discuss this and other smallpox vaccine issues in the third session of this course.

Vaccine Administration

Appropriate vaccine administration is critical to vaccine effectiveness. The recommended site, route and dosage for each vaccine are based on clinical trials, practical experience and theoretical considerations. Vaccines may not protect your patient if they are administered incorrectly. If the wrong site or needle length is used to administer a vaccine, there may be an increased risk of a local adverse reaction. Therefore, an education plan that includes competency based training on vaccine administration should be considered for everyone who administers vaccines.

Delivering vaccine into the appropriate tissue promotes optimal antibody response to a vaccine and reduces the risk of local adverse reactions. So let's talk about route, site and needle length. This information can be found in Appendix G of your book.

Subcutaneous injections are administered into the fatty tissue found below the dermis and above muscle tissue. Subcutaneous tissue is present in most areas of the body. The usual subcutaneous sites for vaccine administration are the thigh and the upper outer triceps of the arm. The upper outer triceps area can be used to administer subcutaneous injections to infants. The recommended needle size for subcutaneous injections in all age groups is a 23- to 25-gauge 5/8 inch

needle. A longer needle could penetrate the muscle, particularly if given at an incorrect angle. To avoid reaching the muscle, the fatty tissue is pinched up and the needle is inserted at a 45 degree angle. A more perpendicular approach is used for IM injection.

The majority of vaccines administered by injection are given by the intramuscular route. Incorrect intramuscular technique can reduce vaccine effectiveness and increase local adverse reactions, so proper technique is critical. Intramuscular injections are administered into muscle tissue below the dermis and subcutaneous tissue. The amount of overlying subcutaneous tissue depends on the person and the site. Although there are several IM injection sites on the body, the recommended IM sites for vaccine administration are the vastus lateralis muscle in the anterolateral thigh and the deltoid muscle in the upper arm. Injection at these sites reduces the chance of involving neural or vascular structures. The site depends on the age of the person and the degree of muscle development. The deltoid muscle is most commonly used in older children and adults. The deltoid muscle can be used in toddlers if the muscle mass is adequate. It is important to use anatomical landmarks to locate the site so that the injection is given into the center of the muscle.

The buttock should NEVER be used to administer vaccines, although it can be used to administer large doses of immune globulin. Injection in the gluteus risks damage to nerve tissue and there is generally more subcutaneous tissue to pass through when trying to reach muscle.

A 22 to 25 gauge needle is recommended for intramuscular injections. The needle length must be adequate to reach the muscle and is based on the size of the individual. The recommended needle length for an infant is 7/8 to 1 inch. The recommended needle length for toddlers and older children is a 7/8 to 1¼ inch. Adults will typically need a 1 to 1½ inch needle. To avoid injection into subcutaneous tissue, the skin of the selected site can be spread taut between the thumb and forefinger, isolating the muscle. Another technique, acceptable mostly for pediatric and geriatric patients, is to grasp the tissue and “bunch up” the muscle. The needle should be inserted fully into the muscle at a 90-degree angle.

Other important vaccine administration issues include infection control, sites for simultaneous administration, and latex allergy.

Hand hygiene is recommended between each patient. When working at a site where it is not feasible to wash your hands before each patient, an **alcohol-based waterless antiseptic can be used** between patients and in situations where your hands become soiled. **Gloves are not mandatory for vaccine administration unless there is the potential for exposure to blood or body fluids, the person giving the shot has open lesions on the hands, or it is an agency policy**. Just remember, gloves cannot prevent a needle-stick injury.

You should **never EVER detach, recap or cut a used needle** before disposal. All used syringe and needle devices should be **placed in puncture proof** containers to prevent needle sticks and reuse. Used injection equipment should be **disposed of as infectious medical waste**.

Here are a few more points about vaccine administration. It is not necessary to **change needles between drawing or reconstituting vaccine and administration** unless the needle is contaminated or bent.

Use a new syringe and needle to draw up each vaccine to be administered. When administering multiple vaccines, **NEVER EVER mix vaccines in the same syringe unless they are approved for mixing by the Food and Drug Administration**. Vaccines approved for mixing will be packaged together or indicated in the package insert. If more than one vaccine is to be administered in the same limb, the **injection sites should be separated by at least an inch, if possible**. This separation allows any local reactions to be differentiated. Vaccines that contain tetanus and diphtheria toxoids may cause more soreness than other vaccines, so you may want to give this vaccine alone or in the limb with a subcutaneous injection.

Aspiration is the process of pulling back on the plunger of the syringe prior to injection to ensure that the medication is not injected into a blood vessel. Although this practice is advocated by some experts, and most nurses are taught to aspirate before injection, there is no evidence that this procedure is necessary. If your procedure includes aspiration and blood appears, the needle should be withdrawn, the dose discarded, and a new needle, syringe, vaccine dose used to administer the injection at a different site. One way to avoid the need to discard an expensive dose of vaccine is just not to aspirate in the first place.

Many people, particularly healthcare providers, claim to have latex allergies. **Latex allergy is most often a contact- type allergy**. There has only been one published report of an anaphylactic allergic reaction following vaccine administration in a patient with known severe allergy to latex. **A person with an anaphylactic allergy to latex should not generally receive vaccines supplied in vials or syringes that contain natural rubber. Persons with latex allergies that are not anaphylactic, such as contact allergy to latex gloves, CAN receive** vaccines supplied in vials or syringes that contain dry natural rubber or natural rubber latex.

With the number of injections that we are giving in immunization practice today, both healthcare providers and parents are concerned about adequate pain control. Comfort measures and distraction techniques may help children cope with the discomfort associated with vaccination. Remember that pain is a subjective phenomenon influenced by multiple factors including a person’s age, anxiety level, previous healthcare experiences, and culture. A variety of measures ranging from topical anesthetics to diversionary techniques are discussed in both the ACIP *General Recommendations on Immunization*, and a vaccine administration document available on our broadcast resource website.

Hello, I'm Mark Sawyer, a pediatric infectious disease specialist on the faculty of the University of California San Diego. For the past several years our Medical School has been working with public health departments to improve national immunization levels. One of the things we often hear from physicians is that they want to make sure they and their staff receive enough training in giving immunization. This video is an answer to that need. Immunization experts from around the country to develop the video you're about to see. It deals with the skills and techniques needed for safe, effective and caring injection of vaccines. It is intended for anyone who provides immunization to children or adults.

That clip was from a video on vaccine administration produced by the California Immunization Program. It's called Immunization Techniques - Safe, Effective, Caring. The video is 35 minutes long and covers all aspects of vaccine administration. It's a great competency- based training tool for your office. The video and associated material cost $25. It's available from the California Distance Learning Health Network, and from the Immunization Action Coalition. We have a link to this excellent package on our broadcast website. We will give you that address in a few minutes.

Vaccine Storage and Handling

The success of efforts against vaccine preventable diseases is attributable in part to proper storage and handling of vaccines. Exposure of vaccines to temperatures outside the recommended ranges can adversely affect their potency and reduce the protection they provide. Storage and handling errors can cost your practice thousands of dollars in wasted vaccine and revaccination. They can also result in the loss of patient confidence in your practice when repeat doses are required.

Vaccines are fragile and must be kept at the temperatures recommended by the vaccine manufacturers at all times. It is better to NOT VACCINATE than to administer a dose of vaccine that has been mishandled. **Live vaccines can tolerate freezing** temperatures. In fact, both varicella vaccine and live attenuated influenza vaccine, or LAIV, MUST be stored in a continuously frozen state at the recommended freezer temperatures until administration. MMR vaccine is usually stored in the refrigerator, but it can also tolerate freezing temperatures. **Live virus vaccines deteriorate rapidly after they are removed from the freezer,** or from the refrigerator in the case of MMR.
On the other hand, **inactivated vaccines are damaged when exposed to freezing temperatures**, and should not be used. However, they can **tolerate short periods of time outside of the refrigerator**, although potency can be adversely affected if left out too long.

Vaccines must be stored properly from the time they are manufactured until they are administered to your patients. The cold chain begins with the manufacturer and continues with the transfer of vaccine to the distributor, transfer from the distributor to the provider's office, and administration to the patient. Proper storage temperatures must be maintained at every link in the chain.

All healthcare providers who administer vaccines should evaluate their cold chain procedures to ensure that vaccine storage and handling guidelines are being followed. Each office should **develop and maintain a detailed written storage and handling protocol**; **assign storage and handling responsibilities to one person**; **designate a back-up person**, and **ensure that both of them are provided with training on vaccine storage and handling**.

Vaccine storage units must be selected carefully and used properly. Refrigerators without freezers, and stand-alone freezers, are usually better at maintaining the required temperatures. However, a combination refrigerator-freezer unit sold for home use is acceptable for vaccine storage if the refrigerator and freezer compartments each have a separate door.

Any refrigerator or freezer used for vaccine storage must be able to **maintain the required temperature range throughout the year**. It must be **large enough to hold the year's largest vaccine inventory**, and must be **dedicated to the storage of biologics**. Food and beverages should NOT be stored in vaccine storage units.

The National Immunization Program discourages the use of small single-door, or dorm style refrigerators like this. This type of unit may be used for storing small quantities of inactivated vaccines or MMR IF the refrigerator compartment can maintain a constant temperature. However, the **freezer compartment** in this type of unit is incapable of maintaining the required temperature range for varicella vaccine and LAIV, and therefore cannot be used to store these vaccines.

Most vaccines require storage temperatures of **35^{o} to 46^{o} Fahrenheit**, which is **2^{o} to 8^{o} Celsius**, with a desired **average temperature of 40^{o} Fahrenheit,** or 5^{o} Celsius. Both varicella vaccine and LAIV must be stored in a continuously frozen state at **5^{o} Fahrenheit**, which is **minus 15^{o} Celsius**, or colder. If you are using both the refrigerator and freezer to store vaccines, be careful not to make the freezer so cold that the refrigerator temperature drops below the recommended temperature range.

Proper temperature monitoring is key to proper cold chain management. Check the temperatures twice a day – once in the morning and once before you leave at the end of the workday. Post a temperature log like this one on the door of the refrigerator or freezer and record the temperature readings twice daily. It is important to **keep temperature logs for at least 3 years**, unless state statutes or rules require a longer period. As the refrigerator or freezer ages, you can track recurring problems or identify how long problems have existed.

While it is important to document the temperatures, documentation is not enough. Equally important is taking immediate action when the temperatures fall outside the recommended ranges. Remember, any mishandled vaccines should NOT be administered. It is especially important that inactivated vaccine that has been exposed to freezing temperature not be administered.

Both the refrigerator and freezer compartments should have their own thermometer. Here are some examples of thermometers that can be used, including **biosafe liquid**, **continuous graphic**, and **minimum maximum**. If you are using a continuous recording thermometer, even though it is recording the temperatures for you, it should still be checked twice each day to make sure the temperatures are in range. Thermometers are a critical part of good storage and handling practice. You should buy the best thermometers your practice can afford.

To keep the refrigerator and freezer cold, the unit must be in good working condition, and it must have power at all times. There are several things you can do to prevent problems. Your refrigerator should have a **plug guard or a safety lock plug** so that it cannot be pulled out accidentally. **Post a warning sign at the plug and on the refrigerator**. **Label the circuit breakers** to alert janitors and electricians not to unplug the vaccine storage unit or turn the power off. And finally, you may want to **install a temperature alarm** to alert staff to after-hours emergencies, particularly if large vaccine inventories are maintained.

You can help stabilize the temperature in the refrigerator by keeping containers of water inside. This liquid bulk helps keep the temperature stable, particularly when the refrigerator is being opened and closed all day. The same principle applies to the freezer. Store extra cold packs or blue ice in the freezer. Not only will they help keep the temperature stable with frequent opening and closing of the door, they will also help keep the temperature stable in the event of a power failure. Providers should also never store vaccines in the door of the freezer or the refrigerator, or in the vegetable bin. The temperatures in these areas are not stable. Use these areas to store liquid bulk and cold packs.

We are frequently asked about prefilling or drawing up doses of vaccine before they are actually needed. The National Immunization Program strongly discourages filling syringes in advance, for a number of reasons. The most important reason to avoid this practice is that filling a syringe before it is needed **increases the risk for administration errors**. Once in the syringe, it is difficult to tell which vaccine is which. Prefilling syringes also **increases vaccine wastage**. Unused syringes you have prefilled should be discarded at the end of the clinic day. Finally, prefilling syringes **may result in bacterial growth in the vaccines** that do not contain a preservative, such as vaccines supplied in single dose vials. As an alternative to pre-filling syringes, **consider using manufacturer-supplied prefilled syringes for large immunization events,** such as community influenza clinics. Syringes other than those filled by the manufacturer are designed for immediate administration and NOT for vaccine storage. However, if you have a reason to draw up more than one dose of vaccine, you should only prefill a few syringes at a time which you will administer yourself. Any **syringes of vaccine other than those filled by the manufacturer should be discarded at the end of the clinic day**.

Vaccine inventory control is a critical part of vaccine quality management. As part of inventory control, providers should **conduct a monthly vaccine inventory** to be sure they have enough to meet their needs. However, **avoid stocking**

excessive vaccine supplies, as this leads to vaccine wastage when vaccines become outdated. Also include diluents in the stock control procedures and ensure adequate diluent supplies are available. Vaccines may only be reconstituted with the specified diluent. Diluents are not interchangeable. Providers should **monitor the expiration date** of their vaccine and diluent supplies and **rotate stock** to avoid waste from expiration. Expired vaccine and diluent should never be used.

It is critical that every clinic have a written emergency vaccine retrieval and storage plan. The most important part of this plan is to identify a location with a backup generator where a provider can move their vaccine in the event of an emergency, such as an equipment failure or power outage. Consider contacting a local hospital, the Red Cross, or a long term care facility as a backup site. Information to assist in developing a written plan is available on the NIP website.

There are also useful storage and handling resources in appendix D of your book, including temperature logs, vaccine storage requirements, and warning signs for your electrical plugs and breaker box.

Other helpful tools will also soon be available from CDC. A new vaccine storage and handling video titled “How to Protect Your Vaccine Supply” will be available from the National Immunization Program in the next few months. In addition, a companion CD containing more detailed vaccine storage and handling information will also be available.

In order for patients to be protected by vaccines, vaccines must be stored and handled with care. With a few simple steps and good practices to maintain proper vaccine storage and handling, we can ensure that the full benefit of immunization is realized.